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Before the  
Federal Communications Commission  
Washington, D.C. 20554

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FEB 27 2001

In the Matter of )  
)  
Deployment of Wireline Services Offering )  
Advanced Telecommunications Capability )  
)  
And )  
)  
Implementation of the Local Competition )  
Provisions of the )  
Telecommunications Act of 1996 )

FEDERAL COMMUNICATIONS COMMISSION  
OFFICE OF THE SECRETARY  
CC Docket No. 96-98

CC Docket No. 96-98

COMMENTS OF CATENA NETWORKS, INC.

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Dated: February 27, 2001

## **Summary**

Catena Networks, Inc. (“Catena”) fully supports the Commission’s goals in this proceeding of facilitating the availability of advanced services to all Americans and fostering competition for those advanced services. Catena has developed products that can meet those goals by providing DSL services from certain legacy remote terminal systems. Catena’s products are based on providing an integrated solution so that POTS and DSL services can be furnished over a single copper loop via an integrated linecard that fits in to existing remote terminals. The Commission should not do anything to discourage the deployment of this most efficient architecture.

In developing regulatory obligations for the incumbent carriers, the Commission should facilitate competition among the incumbent (and competitive) carriers and the other facilities-based broadband providers, including cable television operators, satellite carriers and other terrestrial wireless providers. Imposing excessive burdens on the incumbent carriers or precluding them from fully recovering their costs will not foster competition, because the incumbent carriers will not have the incentive to deploy these beneficial technologies.

Finally, to the extent the Commission adopts some form of end-to-end resale or unbundling of advanced services provided by incumbent carriers via remote terminals, Catena’s products support such a multi-carrier model. Catena’s CNX-5 technology allows multiple carriers to use a shared or segregated backhaul, and its partitioned management system allows the competitive carriers to control their own monitoring, maintenance and provisioning. Although there are still regulatory issues to be resolved under this approach, technology should not be an impediment.

## Table of Contents

	<u>Page</u>
Summary .....	i
The Commission Should Encourage the Availability of Advanced Services Through Deployment of Integrated Solutions Like the CNX-5 System .....	3
The Commission Should Adopt Regulations that Encourage Real and Not Artificial Competition .....	5
If the Commission Adopts a Resale or Virtual Unbundling Model, Catena's Integrated Linecard Technology Can Support Such an Approach.....	10
Conclusion .....	14

**Before the  
Federal Communications Commission  
Washington, D.C. 20554**

In the Matter of	)	
	)	
Deployment of Wireline Services Offering	)	CC Docket No. 98-147
Advanced Telecommunications Capability	)	
	)	
And	)	
	)	
Implementation of the Local Competition	)	CC Docket No. 96-98
Provisions of the	)	
Telecommunications Act of 1996	)	

COMMENTS OF CATENA NETWORKS, INC.

Catena Networks, Inc. ("Catena") hereby comments on the Commission's Third Further Notice of Proposed Rulemaking in CC Docket No. 98-147 and Sixth Further Notice of Proposed Rulemaking in CC Docket No. 96-98 concerning collocation of Competitive Local Exchange Carriers ("CLECs") in remote terminals deployed by the Incumbent Local Exchange Carriers ("ILECs") where the ILEC has deployed remote terminal technology.<sup>1</sup> As discussed below, Catena has developed an integrated linecard technology – the Catena CNX-5 Broadband System – that allows carriers economically to provide DSL services to customers served by certain "legacy" remote terminals. Catena is also developing other next generation digital loop carrier systems. Catena believes the public interest would be ill-served if artificial regulatory constraints or improper pricing

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<sup>1</sup> *Deployment of Wireline Services Offering Advanced Telecommunications Capability*, FCC 01-26, released January 19, 2001 (hereafter cited as "*Further NPRM*").

requirements prevented carriers from deploying these technologies, and thereby precluded consumers in many parts of this country from receiving broadband services.

Catena is well qualified to address the technical issues raised in the *Further NPRM*. Catena was founded in 1998 by a seasoned team of senior executives and engineers that pioneered development of mass-market voice and data access solutions. The company seeks to help service providers establish affordable and efficient broadband links to their subscribers. Catena is headquartered in the heart of Silicon Valley in California, and maintains a state-of-the-art research and development center in Kanata, Ontario, where it employs some 200 engineers developing broadband solutions.

Catena recently announced the availability of its CNX-5 Broadband ADSL system for upgrading Lucent SLC® Series 5 ("SLC-5") Digital Loop Carrier systems. The CNX-5 technology allows carriers to provide customers served by SLC-5 remote terminals with both POTS and ADSL service on any copper pair, without reducing the number of available POTS lines. Catena's product provides carriers with a fast, cost-effective and scalable way to provide DSL services to the more than 20 million residential subscribers now served by SLC-5 remote terminals.

The CNX-5 system contains three elements: (1) the Catena Enhanced Channel Unit integrated linecard that provides two POTS and two DSL lines (which fits in the current SLC-5 two POTS linecard port); (2) the Catena Enhanced Channel Test Unit ATM multiplexer card for multiplexing and management of the DSL service (which fits in the current SLC-5 channel test unit and also provides that functionality); and (3) the CatenaView Element Management System (which provides provisioning and management functionality for the DSL service and integrates with upstream Operation

Support Systems). Attachment A to these comments is a more detailed description of the capabilities, characteristics and specifications for these CNX-5 products. In addition, Catena is developing its own broadband loop carrier remote terminal – the CN1000 – Broadband Loop Carrier. All of these Catena products are designed to accommodate the expected network convergence, where all traffic (voice and data) will travel through soft switches and be routed over packet-based networks.

**The Commission Should Encourage the Availability of Advanced Services Through Deployment of Integrated Solutions Like the CNX-5 System**

Catena has developed a technology that fulfills the well-documented need for broadband services that cannot economically otherwise be provided for some 20 million customers served by certain legacy remote terminals. As the Commission and the Telecommunications Act of 1996 recognize, advanced services are critical to the economic and educational well being of consumers in the new digital marketplace.<sup>2</sup> Thus, the Commission should take steps to facilitate the deployment of advanced services to all Americans.

DSL services are forecast to be a prime source of connectivity to the new information superhighways, and they allow POTS and advanced services to be provided simultaneously over the same loop.<sup>3</sup> However, there are limits on the length of the copper loop between a subscriber and the telephone company central office over which

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<sup>2</sup> See, e.g., Telecommunications Act of 1996, Section 706; *Deployment of Wireline Services Offering Advanced Telecommunications Capability* (First Report and Order), FCC 99-48, released March 31, 1999 at ¶ 5.

<sup>3</sup> In addition to DSL over a telephone subscribers copper loop, broadband services are also provided today via cable television facilities, satellites and terrestrial wireless technologies.

DSL services can be provided reliably and robustly. With current technology, a subscriber's copper loop needs to be less than 18,000 feet in length in order to obtain DSL service. Remote terminals can extend the area where DSL service is available by utilizing a shared broadband path between the remote terminal and the central office, thus shortening the copper loop path to the distance between the remote terminal and the subscriber's premises. In this way, DSL services can be provided to subscribers outside the three-and-a-half mile zone surrounding the telephone carriers' central offices.

Although remote terminals can resolve the distance limitations on DSL services, these services will not be deployed unless they also meet economic hurdles. Catena believes this is best accomplished through use of an integrated linecard. Under Catena's CNX-5 solution, an integrated POTS + DSL linecard fits into the existing remote terminal linecard slot. DSL gains direct access to the POTS loop, thus eliminating any complex and time-consuming wiring to the protection block, Subscriber Access Interfaces, POTS Splitters, etc. This allows for easy access to the POTS loops and eliminates the need for complex access schemes requiring changes to the back plane. In addition, the integrated POTS + DSL linecard eliminates the need for incremental equipment, additional cabinets, larger cabinets, pouring new pads and all the other similar issues related to "overlay" solutions involving deployment of DSLAMs and corollary equipment at the remote terminals.

With advanced technologies such as Catena's, the POTS + DSL linecard takes up no more room and virtually no more power than a linecard offering POTS only, and the scalable implementation is a highly efficient way to incrementally deploy service.

Under the integrated model, the POTS service remains intact and the voice traffic continues to be backhauled to the Central Office over the existing POTS transport infrastructure. There are no changes or impacts to the existing voice operations, maintenance or procedures.

For the embedded base of SLC-5 remote terminals, Catena's CNX-5 products are the only economical way to provide DSL services. There is not adequate extra room, power or heat dissipation to allow collocation of even mini-DSLAMs, so an overlay system is unlikely to be deployed. In addition, given the absence of a concentrated subscriber base typically served by the legacy SLC-5 remote terminals, the carrier is unlikely to remove those terminals entirely and replace them with a Next Generation Digital Loop Carrier. Therefore, if an integrated linecard technology is not deployed, then the 20 million subscribers served by these embedded remote terminals will not have access to DSL services.<sup>4</sup> Thus, the Commission should avoid imposing measures in this proceeding that would have the effect of precluding or retarding the deployment of integrated linecard technology.

**The Commission Should Adopt Regulations that Encourage  
Real and Not Artificial Competition**

As a manufacturer, Catena strives to apply engineering solutions to marketplace demands. As technical experts, Catena feels strongly that an integrated linecard solution is generally the most efficient way to provide DSL services to subscribers served by

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<sup>4</sup> The Commission recognizes that advanced services generally are not as available today in less densely populated areas as compared to more densely populated territories. *Deployment of Advanced Telecommunications Capability: Second Report*, August 2000, at ¶ 88.



remote terminals, and certainly the most efficient way to provide advanced services to customers served by SLC-5 remote terminals. Catena does not claim any special expertise in divining Congressional intent so as to ascertain what obligations the Commission should impose on the incumbent carriers when they provide advanced services via remote terminals. In developing those regulatory requirements, however, the Commission must be mindful that "competition" as a goal includes both competition between the ILECs and DLECs using portions of the incumbent carriers' networks, along with competition among the ILECs (and DLECs) and broadband service providers that make no use of the incumbent carriers' copper loops, including cable service providers, satellite carriers and terrestrial wireless service providers.

In marketing efforts with the incumbent carriers, Catena has learned that some of the regulatory obligations contemplated by the Commission create real disincentives to the ILECs' deployment of Catena's products. In addition, some of the uncertainty now surrounding the ILECs' obligations has led to confusion as to whether deployment of an integrated linecard solution is even permissible. These "clouds" over the provision of advanced services via remote terminals threaten to delay or prevent the deployment of this technology, and thus severely limit the ability of telephone company provided DSL services from competing against broadband services already being offered by cable companies, satellite carriers and terrestrial wireless operators.

In order to facilitate such intermodal competition, the Commission should use this proceeding to make clear that the incumbent carriers may deploy integrated linecard solutions. As Catena has indicated previously, line splitters are inefficient and

unnecessary for an integrated linecard technology such as Catena's.<sup>5</sup> The Commission should remove any ambiguity and clarify that the ILECs are not *required* to deploy a line splitter as a demarcation or interconnection point when those devices are rendered superfluous by integrated linecard technologies.<sup>6</sup>

Equally important, to the extent the Commission creates unbundling, collocation or resale obligations, it must allow the incumbent carriers to fully recover the costs of providing those services or capabilities. As an expert in technology, Catena takes no position as to the extent to which the Telecommunications Act of 1996 compels the ILECs to unbundle advanced services. However, as a manufacturer marketing advanced services products, it is all too aware of the inhibitions to the ILECs' deployment of new technology caused by inaccurate pricing. The incumbent carriers will have little or no incentive to make capital investments in DSL technologies if they are required to provide their competitors access to those capabilities at prices that are below cost.

False price signals for integrated linecard technology can arise in two contexts – by imposing excessive overlay solution regulatory burdens on the ILECs without allowing them to recover the costs of those obligations, or by requiring the ILECs to provide access to integrated linecard technology network elements or services at below cost rates.

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<sup>5</sup> Comments of Catena in CC Docket Nos. 98-147 and 96-98, October 12, 2000 at pp. 11-19.

Physical line splitters have a number of drawbacks, including stranding precious bandwidth; preventing complete testing of the full frequency range without complicated additional wiring arrangements; and finally, posing potential complications in current models that require access to the full bandwidth spectrum in the copper loop.

With respect to the first types of regulatory disincentives, Catena believes it would disserve the public interest if the Commission imposed "overlay solution" obligations on the incumbent LECs (such as requirements to maintain copper loops or deploy overly large remote terminal cabinets) without allowing them to fully recover the costs of these regulatory burdens. As a result, the regulatory "costs" of deploying new technologies would exceed the economic costs, and thus would reduce the incentives for deploying the new network architecture.

If the Commission imposed the various obligations requested by the competitive LECs (such as requiring the incumbent LECs to maintain copper loops), but allowed the incumbent LECs to recover those costs from the cost causers, then the result would likely be less efficient telecommunications networks, presumably offset somewhat by competition. Of course, to the extent any such requirements decreased the efficiency of DSL services, then the ILECs (and DLECs) would not be able to compete as effectively with the cable companies, satellite service providers and terrestrial service providers that are also offering broadband services. However, at least the Commission would not be more directly discouraging the deployment of advanced technologies, as would be the case if the Commission effectively required the ILECs' customers to subsidize the operations of the DLECs by not allowing the incumbent LECs to collect the full costs of the added obligations from the competitive LECs.<sup>7</sup>

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<sup>7</sup> Conversely, with the correct pricing signals, the competitive LECs would have the incentive to request only the types and amounts of services they need. By way of example, the Commission should recall that when the local exchange carriers were precluded from imposing minimum monthly usage charges for access services (despite the fact that such charges would have been consistent with the manner in which costs were incurred), the interexchange carriers ordered much more capacity than they needed because it was "free." As a result, there was a significant waste of resources. On the

Likewise, if the Commission imposes resale, unbundling or virtual unbundling obligations on the ILEC if they deploy an integrated linecard solution as a means of fostering competitive entry by DLECs, the Commission must allow the ILECs to recover the full costs of providing those services or functions. A failure to do so will significantly reduce the ILECs' incentives to deploy such technology, because of the increased risk that the carriers will be unable to recover their costs or compete effectively against the other carriers providing broadband services. The incumbent carriers would be unable to attain adequate revenues if their competitors could readily underprice the ILECs by buying capacity or service from the ILECs below cost, without even any need to risk any investment of their own.

Any efforts to "jump-start" competition by requiring the ILECs to provide their competitors with resale or unbundled access to advanced services capabilities at less than cost will backfire, because the ILECs will not have any incentives to deploy advanced services technologies.<sup>8</sup> Without these carrier-provided DSL services, many consumers will be denied the benefits of a competitive market or be denied access to broadband services altogether. The public interest would be disserved by such a result.

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other hand, if the incumbent LECs are permitted to charge prices above the costs of these obligations, then it would discourage the competitive LECs from deploying their equipment in remote terminals even in cases (such as certain high density situations) where it would be economical to do so.

<sup>8</sup> Thus, this situation differs from the Commission's unbundling of the current network, because those investments have already occurred (*i.e.*, sunk costs). Here we are dealing with regulatory decisions that will be significantly affecting the ILECs' current decisions whether to invest in new technologies.

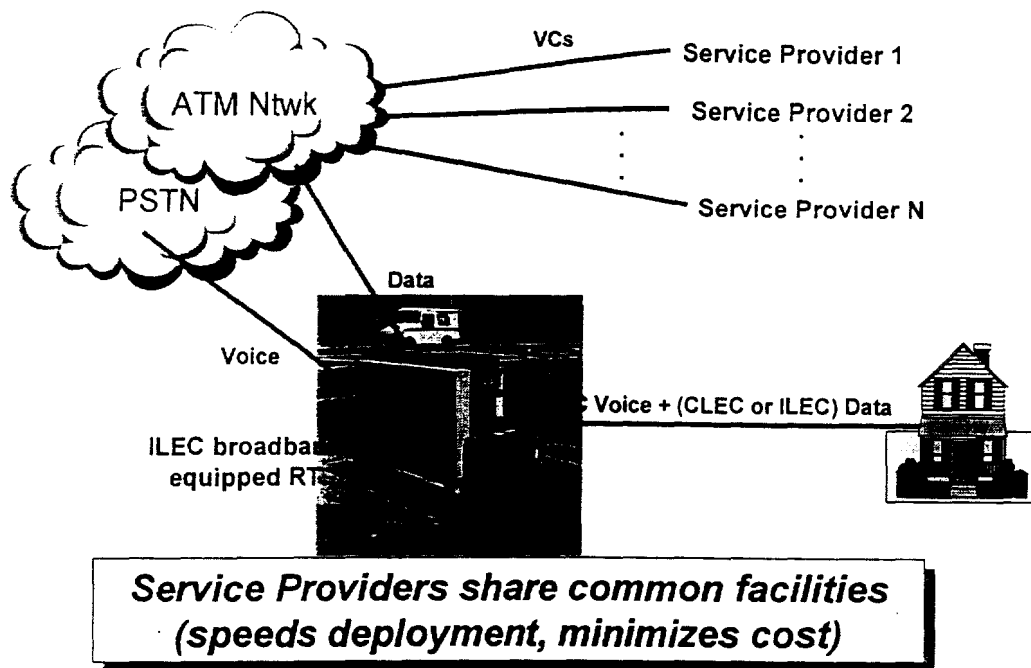
**If the Commission Adopts a Resale or Virtual Unbundling Model, Catena's  
Integrated Linecard Technology Can Support Such an Approach**

As indicated above, Catena does not take a position on whether the Commission can require the ILECs to provide access to particular advanced services or network elements under the Telecommunications Act of 1996. To the extent it does, however, Catena's products can readily support multiple carriers providing DSL services to customers served by certain legacy remote terminal systems. Although there are regulatory, accounting and policy issues raised by such a model, as demonstrated by the capabilities of Catena's products, technology would not be an impediment.

In the context of granting SBC a waiver of the merger conditions to allow it to deploy next generation digital loop carriers for the provision of advanced services, the Commission and SBC relied on a model of multi-carrier provision of DSL services using integrated linecard technology.<sup>9</sup> Under this approach, the most efficient design would have the high-speed data traffic carried over a high-capacity channel between the remote terminal and the central office, and then be distributed to the competitive carriers through virtual circuits. Figure 1 below illustrates such an architecture, and is consistent with Catena's CNX-5 product currently available for deployment in SLC-5 remote terminals.

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<sup>9</sup> *Ameritech Corp. and SBC Communications, Inc., Second Memorandum Opinion and Order*, FCC 00-336, released September 8, 2000 (hereafter cited as "*Pronto Waiver*").



**Figure 1**

Under such a scenario, the Catena integrated linecards could provide both POTS and DSL service in two customer increments. In addition, Catena's ECTU multiplexer can be configured so that all of the data traffic is carried back to the central office over a single high capacity channel (currently a T1 or DS3 channel), or it can provide the data backhaul via up to four separate T1 IMA channels. Finally, the CatenaView Element Management System incorporates the capability of partitioned OSS functionality, so that multiple carriers could perform monitoring, maintenance, testing and provisioning of (only) their own customers' DSL services.<sup>10</sup>

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<sup>10</sup> Competing carriers would be able to view graphic representations of their virtually collocated linecards on the CatenaView System, enabling them to remotely deploy and monitor services offered to their customers in a secure arrangement, segregated from customers of the ILEC, and vice versa.

Catena recognizes that while such a model for multi-carrier DSL service is supported by Catena's technology, regulatory complications remain. For example, while the Enhanced Channel Unit Card allows the ILEC or DLEC to deploy DSL service from a SLC-5 terminal in increments of two, the Enhanced Channel Test Unit is a single card addressing all of the lines served by the remote terminal. Thus, while it would theoretically be possible for multiple competing carriers to "virtually collocate" integrated subscriber linecards,<sup>11</sup> only one carrier (presumably the incumbent carrier) could own and deploy the Enhanced Channel Test Unit. Thus, it would be necessary to allocate the costs of that component among the various carriers (including voice service providers, insofar as the ECTU provides the testing function for the POTS lines as well). In a similar vein, the CatenaView Element Management System, which can control multiple SLC-5 terminals, would presumably be owned and maintained by the incumbent carrier, and those costs would need to be allocated among the various DSL providers. Likewise, it would be necessary to allocate the costs of the other shared functionalities of the remote terminal, including maintenance, power, heat dissipation, the cabinet, etc. As discussed above, it is critical that the Commission allow the incumbent carriers to fully recover the costs of these services/elements.

Similar cost allocation, ownership and responsibility issues are raised in the context of line sharing or line splitting. In both cases, Catena's Enhanced Channel Unit linecard will support two POTS and two DSL lines, and different carriers could be providing those different services. In theory, up to four different carriers could be using

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<sup>11</sup> As far as Catena is aware, the Commission does not require actual physical collocation within a switch, whether it is located at a Central Office or Remote Terminal.

the same linecard to provide service. In the context of line sharing, the regulators are determining the cost allocations and other issues. It is not clear, however, whether there would be a need for similar regulatory intervention if a CLEC "owns" the card and a DLEC seeks line splitting, or whether the Commission will simply rely on market forces to address those issues in that situation.

With respect to the backhaul from the remote terminal to the central office, Catena's CNX-5 system can support use of a single high-capacity channel, or multiple channels (up to four). Typically, the most efficient means of carrying that data traffic will be over a single high-capacity channel, although the amount of traffic and actual facilities between the remote terminal and the central office would normally dictate what backhaul facilities are used. If multiple carriers will be using a single backhaul channel, then it will be necessary to allocate the costs of that facility/service among the carriers. In addition, such cost allocations will be further complicated if the different carriers desire differing levels of backhaul service (*e.g.*, guaranteed data rates).

In this regard, Catena observes that the competitive carriers have indicated an interest in providing varying levels of service instead of merely reselling the "plain vanilla" DSL offerings of the ILECs.<sup>12</sup> Catena observes that the CNX-5 system allows service differentiation through the partitioned OSS functionality and its control over the ECTU, along with the competitive carrier's ability to perform its own monitoring and testing. Thus, Catena's products would appear to be compatible with the desires of the

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<sup>12</sup> *E.g.*, Comments of DSLNet Communications Inc., CC Docket Nos. 98-147 and 96-98, October 12, 2000 at p. 13; Comments of Mpower Communications Corp., CC Docket Nos. 98-147 and 96-98, October 12, 2000 at pp. 46-47; Comments of Rhythms NetConnections, CC Docket Nos. 98-147 and 96-98, October 12, 2000 at pp. 22-24




competitive carriers, while also allowing the incumbent carriers to provide DSL services to customers served by certain legacy remote terminals who otherwise could not get access to these advanced services. In sum, Catena's products can support a multi-carrier model for the provision of advanced services provided via remote terminals, although regulatory issues still must be resolved.

### **Conclusion**

The Commission's original model for the competitive provision of DSL services via the "unbundling" of the high frequency portion of a copper loop has been supplanted by technological developments in remote terminal deployments. In refining those regulatory obligations, the Commission must be careful not to stifle this new technology, and thereby reduce the ability of DSL services to compete against the broadband offerings of cable service providers, satellite carriers and terrestrial wireless service operators. Imposing excessive costs on the ILECs or denying them the ability to recover fully their costs would have such an effect, and thus would run counter to the goals of

encouraging advanced services to all Americans and fostering competition. As described herein, Catena believes that its products are fully compatible with both goals.

Respectfully submitted.

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Dated: February 27, 2001

## **ATTACHMENT A**

# CNX-5

The CNX-5 is a simple, elegant, and inexpensive Asymmetric Digital Subscriber Line (ADSL) upgrade solution for the Lucent SLC® Series 5 Carrier System. This new deployment approach enables service providers to deliver both Plain Old Telephone Services (POTS) and ADSL services on any copper pair without compromising POTS density. The CNX-5 leverages the investment in installed Digital Loop Carrier (DLC) equipment making it the most cost effective solution for delivering DSL services from the DLC. The CNX-5 upgrade is inexpensive to purchase and install, expands in two channel increments, and provides T1, nxT1, and DS-3 trunk options to leverage available backhaul bandwidth.

Based on the SLC Series 5 chassis, the CNX-5 solution consists of three components: an integrated 2 POTS and 2 DSL port channel unit, an ATM multiplexer card and the CatenaView Element Management System (EMS).

Catena Networks' CNX-5 solution is ideal for service providers to quickly respond to DSL service demand served by their installed base of SLC Series 5 remote terminals.

## DSL Upgrade Highlights

An ATM multiplexer common card and a two-line POTS/DSL channel unit card are all it takes to upgrade the SLC-5 to support DSL.

The CNX-5 requires no external cabling, no "pizza boxes", no POTS splitters, and no additional pads and cabinets — just a simple card-for-card upgrade.

Lower start costs, lower expansion costs, and lower inventory costs make the CNX-5 much less expensive than Mini-RAMs, and remote DSLAMs.

The CNX-5 provides cost effective growth in two-line increments without reducing POTS port count. CatenaView EMS is expandable to tens of thousands of lines.

Catena's Programmable Full Spectrum Management silicon technology embraces ADSL standards evolution by not "stranding" spectrum behind hard-wired POTS splitters.

The CNX-5 DSL Upgrade System is applied to the installed base of SLC-5 Series 5 Digital Loop Carrier Systems. With the CNX-5 solution, the SLC Series 5 can be DSL equipped with simple card-for-card replacements — with no reduction in POTS capacity.

## The SLC Series 5 DSL Upgrade System

### The Challenge

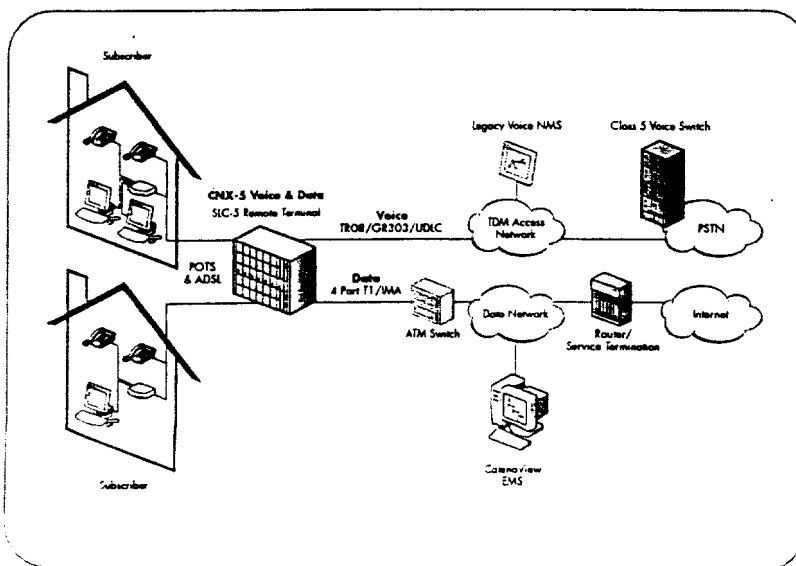
The exploding demand for residential broadband service, and rapidly expanding competition from cable providers has created an urgent need for service providers to deliver DSL to customers serviced by DLCs. However, current solutions for delivering DSL from remote terminals — ranging from remote DSLAMs to bolt-on Mini-RAM systems — are bulky, cumbersome and not cost-effective. These solutions require additional space in a remote terminal cabinet, or worse, an incremental investment in additional concrete pads and cabinets. What is needed is a solution that provides a quick, simple and reliable upgrade to the existing installed base of SLC Series 5 systems — one that is cost-effective yet provides considerable capacity for growth.

### The CatenaView Solution

To meet this need, Catena Networks introduces the CNX-5 SLC Series 5 DSL Upgrade System. It is a simple, elegant and cost-effective way to leverage an investment in SLC Series 5 DLC installations to easily introduce residential DSL. Part of its simplicity is owing to its three part make-up: an integrated 2 POTS plus 2 DSL port channel unit card, an ATM multiplexer card and the CatenaView Element Management System EMS.

### CNX-5 Within the Network

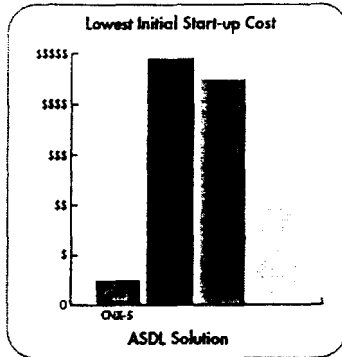
The CNX-5 is a simple card replacement ADSL upgrade solution that resides in the SLC Series 5 access platform located in a remote terminal. Standards-based and widely interoperable with all popular ADSL CPE, it provides the data transmission and voice interface between end users and the central office. Catena's CNX-5 upgrade is comprised of a common card called the Enhanced (ATM Mux) Channel Test Unit (ECTU) and the Enhanced Channel Unit (ECU). Together, these cards provide the added functionality of a DSLAM while preserving the functionality of POTS and legacy services on the SLC Series 5.



The CNX-5 Upgrade System provides a simple, elegant and cost-effective way to introduce DSL transmission to the remote SLC-5 DLC.

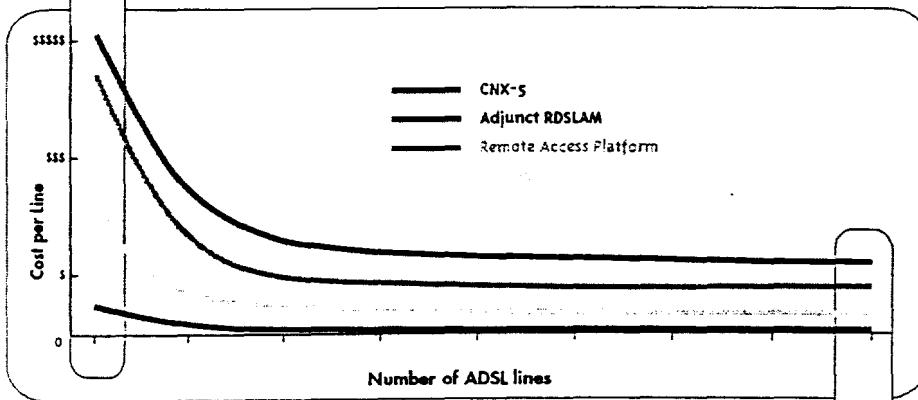
The CNX-5 solution is a simple card-for-card replacement for the SLC Series 5 system, comprised of an Enhanced Channel Unit (ECU) card, an ATM Mux Enhanced Channel Test Unit (ECTU) card and the CatenaView EMS. The ECU card provides

The CNX-5 provides an attractive price curve when compared with alternatives. It is inexpensive to introduce, expands in two-line increments, and achieves densities well beyond alternative solutions. Subtending support linking multi-cabinet sites enables additional flexibility to ensure truly effective WAN utilization. Equally important, the CNX-5 remains less expensive to maintain on a per line basis when compared to other available solutions, and provides significant operations savings when faced with service churn.



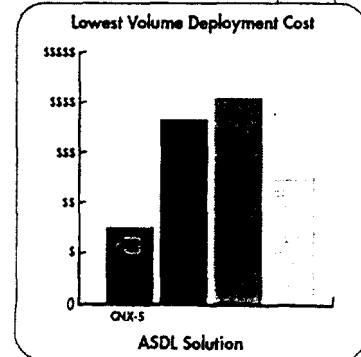
### ADSL Per Line Cost Comparison

The CNX-5 provides an attractive cost curve when compared with alternatives.

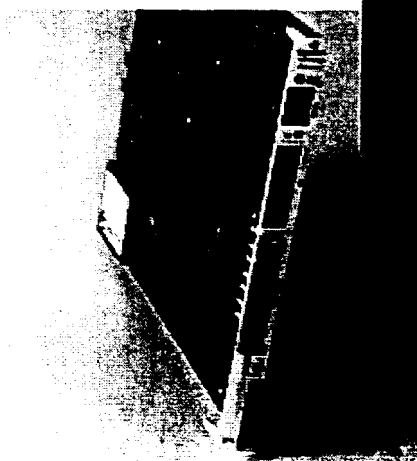


two lines of POTS and two lines of ADSL per card and performs all line functions associated with POTS and ADSL. The ECTU card performs all multiplexing, ATM, and uplink functions, in addition to the existing legacy functions.

Unlike other upgrade solutions, Catena's CNX-5 solution requires no external cabling, no wedging of Mini-RAMs into any available space, and no POTS splitters — just simple, elegant card insertions into the existing chassis. Elegant because an ECTU card replaces the existing Channel Test Unit (CTU) card to make the remote terminal DSL-ready, and because of the scalability that allows growth in accordance with demand through simple CU replacements. Voice services are provisioned in the same way as with legacy ECU cards, and data services are provisioned from the Network Operating Center (NOC), consistent with existing DSL service. As a result, there is minimal investment to train technical personnel on the operation of the equipment.



To support DSL services on the SLC Series 5, the existing CTU card is replaced with Catena's single common ECTU card. While the ECTU retains the legacy CTU functionality, it also provides the DSLAM functionality in the SLC-5. The CNX-5 utilizes existing system



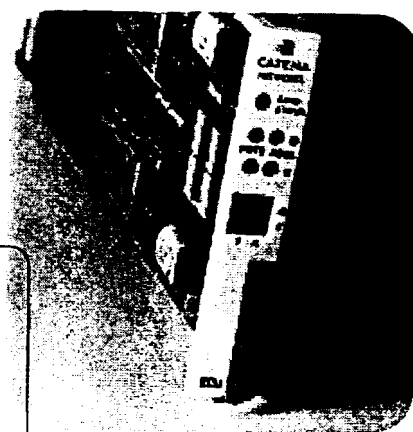
The Enhanced (ATM Mux) Channel Test Unit card performs all multiplexing, ATM and backhaul trunk functions

resources on the SLC Series 5 to communicate between the ECU cards and the ECTU.

This architecture avoids the requirement for any external cabling, whether between cards, or to an external POTS splitter. This greatly simplifies the installation process.

The ECTU provides a local craft configuration interface to manage and configure the DSL system with minimal effort, in addition to the CTU's existing craft interface for testing and configuring special services. LEDs are provided to reflect the status of the system. Once installed in the SLC-5 chassis and connected to backhaul facilities, the ECTU is ready to be provisioned for DSL services from the Network Operations Center.

Recognizing that backhaul resources available to a SLC Series 5 can be scarce, the CNX-5 upgrade offers three backhaul options — T1, 4xT1 IMA, and DS-3. These options enable the carrier to get started inexpensively and grow backhaul bandwidth as it is required and available.

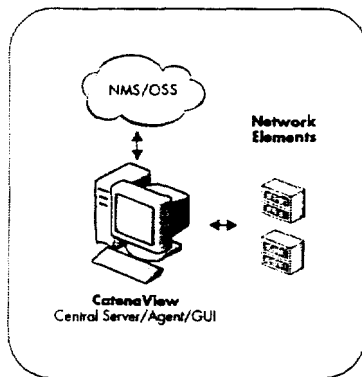


The Enhanced Channel Unit card combines POTS and data line transmission technology.

#### Catena Enhanced Channel Unit (ECU)

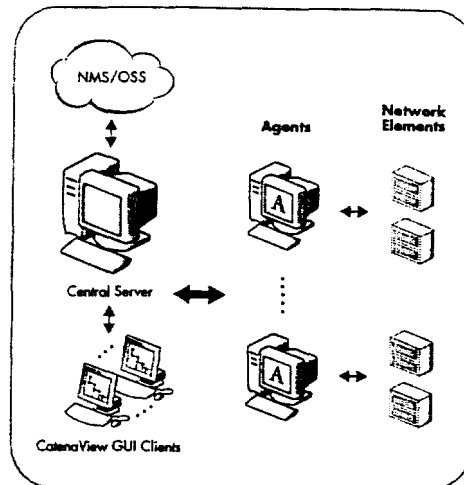
The ECU card uses Catena's industry leading integrated POTS/DSL line interface technology complying with relevant TR-TSY 57 voice, T1.413 and G.992.1 (G.dmt) and G.994.1 (G.handshake) data standards. For voice services, the ECU supports standard POTS functionality. When inserted into the SLC Series 5 chassis, the ECU operates as a standard SLC-5 POTS channel unit. To the service technician, the ECU installs the same way as a standard SLC-5 channel unit with familiar LED displays. For DSL services, the ECU is provisioned the same way as standard DSL services from a DSLAM.

The Catena CNX-5 solution is a simple, elegant and cost-effective way to leverage SLC Series 5 DLC installations to generate new revenue by easily introducing mass market DSL services.



**Initial Roll-out:**

The CatenaView Central Server, Agent, and Client GUI can reside on the same hardware platform.



**As You Grow:**

To scale the system, CatenaView Agents can be given control of multiple Catena devices. The Central Server provides the single point of access for OSS, NMS, Windows or Sun clients. Communications between all EMS components use CORBA interfaces.

### CatenaView Element Management System (EMS)

The CNX-5 has been developed with a recognition that when integrating DSL into an existing SLC Series 5, it is important to provide robust tools for provisioning and managing the DSL service, while ensuring that the processes and procedures used to provision and manage the POTS service remain unaffected. Accordingly, POTS provisioning and management on the CNX-5 remains unchanged from the standard SLC Series 5 implementation. All POTS provisioning and trouble-shooting methods are the same for Catena ECUs as for standard channel units in the SLC Series 5.

To support the provisioning and management of mass market DSL services, the CNX-5 utilizes Catena Networks' robust CatenaView EMS and complete Application Programming Interface (API) suite. CatenaView is expandable to tens of thousands of lines and can be distributed across client/server platforms for optimum performance and reliability. The full-featured API suite provides the interfaces necessary to electronically link the CNX-5 to upstream Operation Support Systems (OSSs) for flow-through provisioning and reporting.

CatenaView's CORBA API uses a TCP/IP-based protocol to enable natural northbound interoperability regardless of platform, operating system, programming language, network hardware or software. The CatenaView CORBA API facilitates seamless integration into northbound NMS and OSS legacy systems using industry standard technology. By utilizing Catena's CORBA API, service providers are able to achieve true ADSL flow-through provisioning right from the NOC.



The CNX-5 supports full ATM capabilities for the most advanced service requirements. Services include all AAL types with full per virtual channel (VC) quality of service (QoS) with overbooking and support for UNI3.0, UNI3.1, and UNI-based SPVC for reduced network operations. Full congestion management includes EPD/PPD. Both sub-channels per DSL line (high latency and low latency) are supported with up to 16 PVCs in any combination of QoS per subscriber line. Full OAM functionality is provided. The system is multicast ready and will migrate to support PNNI, UNI4.0, auto-configuration of ATU-R via ILMI, subtending services, subscriber side SVC services, and packet services.

#### ITU Standards Compliance

- ITU 992.1 (G.dmt)
- ANSI T1.413 Issue 2

#### Interoperability

- Fully Interoperable with all major ADSL chip sets
- Fully Interoperable with Full Rate and G.Lite CPE (ATU-Rs) including popular vendors such as Efficient, 3Com, Westell, Alcatel, and others

#### Software and Serviceability

- Software and configuration downloads from CatenaView
- Full OAM suite including F5 loopbacks and performance statistics

#### Power Supply Options

- Derived from -48Vdc in SLC RT

#### Reliability

- Easy Recovery — Relevant DSL provisioning data is stored in non-volatile memory to allow for ADSL service recovery from power outages without EMS intervention
- AC Monitor feature — Enables turn-down of DSL service in the event of power outages in order to preserve lifeline POTS battery life

#### Operating Environment

- Operating Temperature Range: -40°C to +65°C; -40°F to 150°F
- Storage Temperature Range: -40°C to +65°C; -40°F to 150°F
- Altitude: 4,000 m/12,000 ft
- Relative Humidity: 5% to 90% non-condensing